A BRIEF INTRODUCTION INTO PYTHON

Week 1 of 3

OVERVIEW

- Anaconda & IDES
  - *Spyder & Jupyter Notebooks*
- Data Types in Python
- Basic Mathematic Operators & Functions
- Libraries and Packages
  - *NumPy, SciPy, Matplotlib*

ANACONDA & IDES

LET'S DOWNLOAD ANACONDA

What's Anaconda?

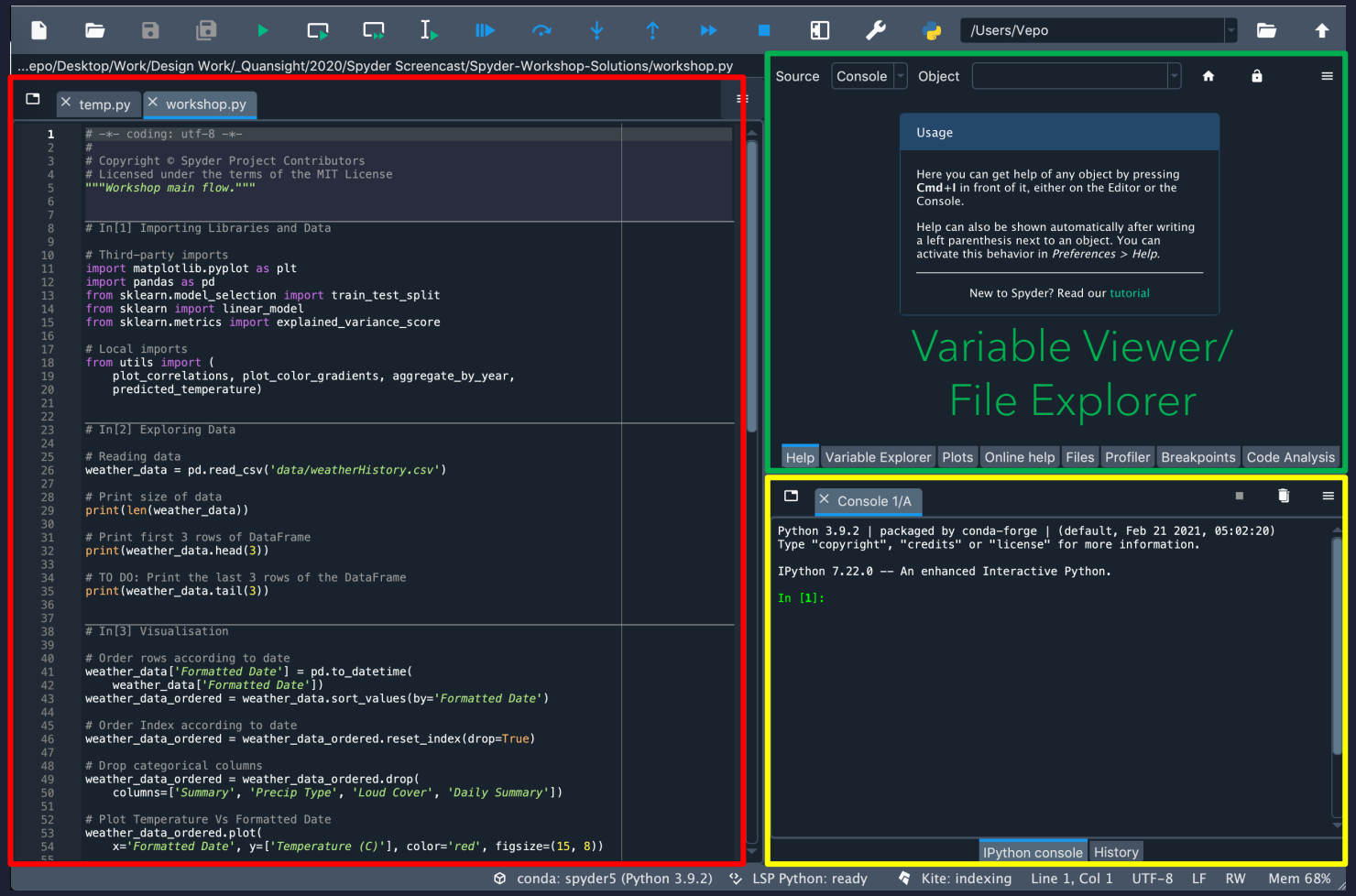
Open-source distributor for python/R-IDEs

What's an IDE?

Integrated Development Environment

Spyder

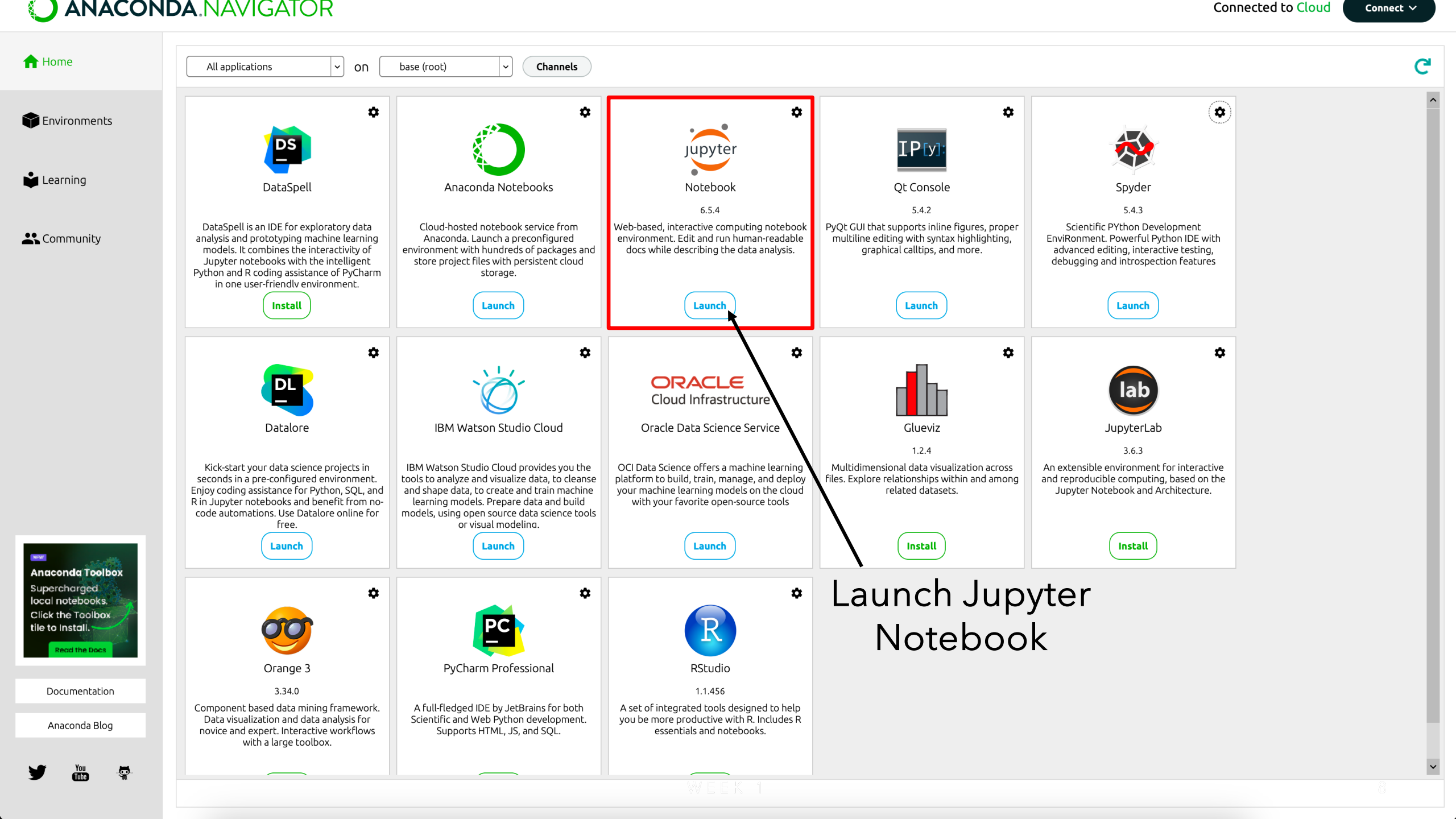
- An IDE
- Best formatted for writing ".py" scripts and testing them out
- Variable Viewer and Directory Viewer



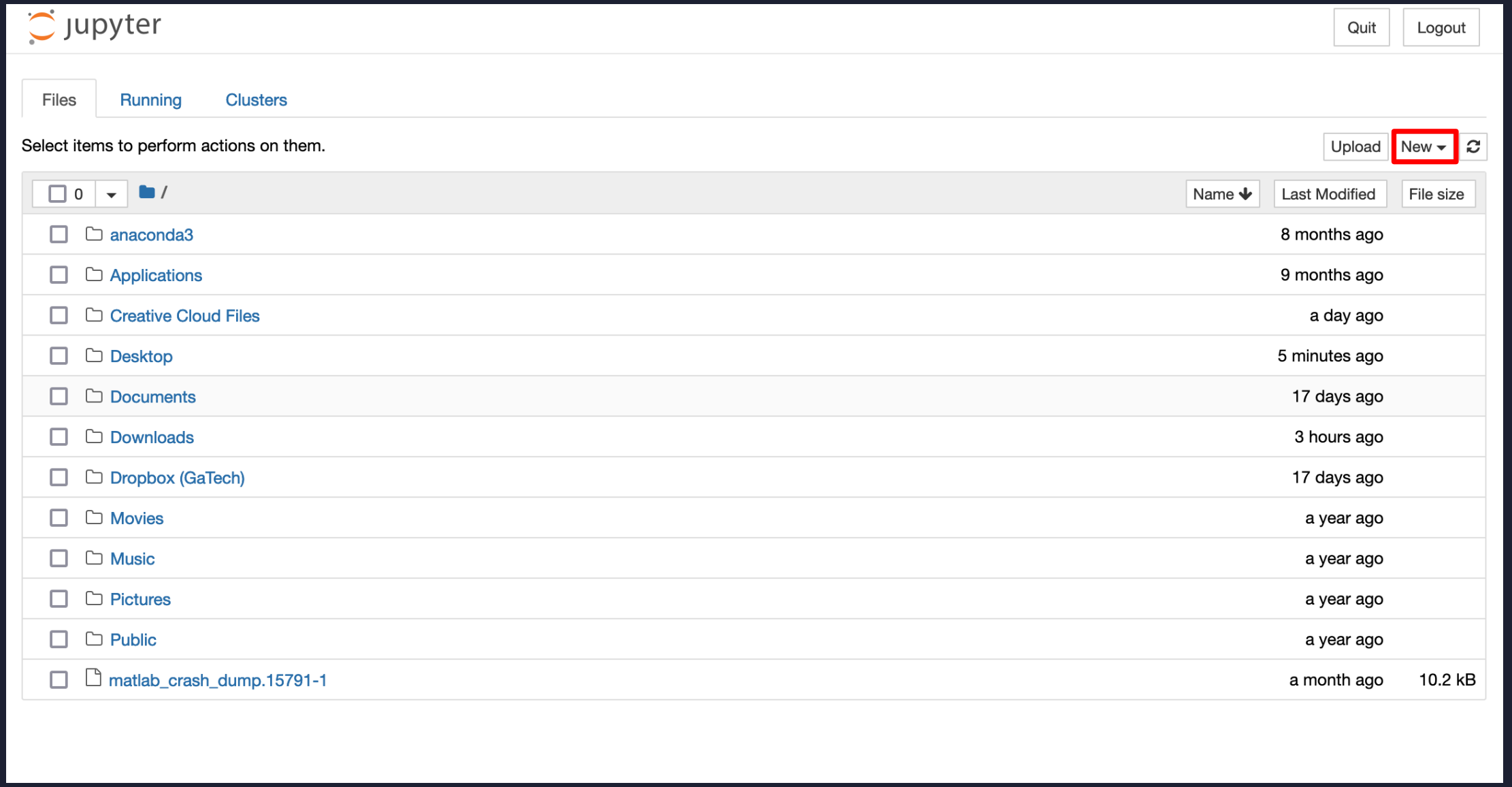
JUPYTER NOTEBOOKS

- Interactive Python Editor
- Can write basic ".py" scripts and notebooks ".ipynb"
- Annotate Notebooks

WE'RE USING JUPYTER NOTEBOOK TODAY!

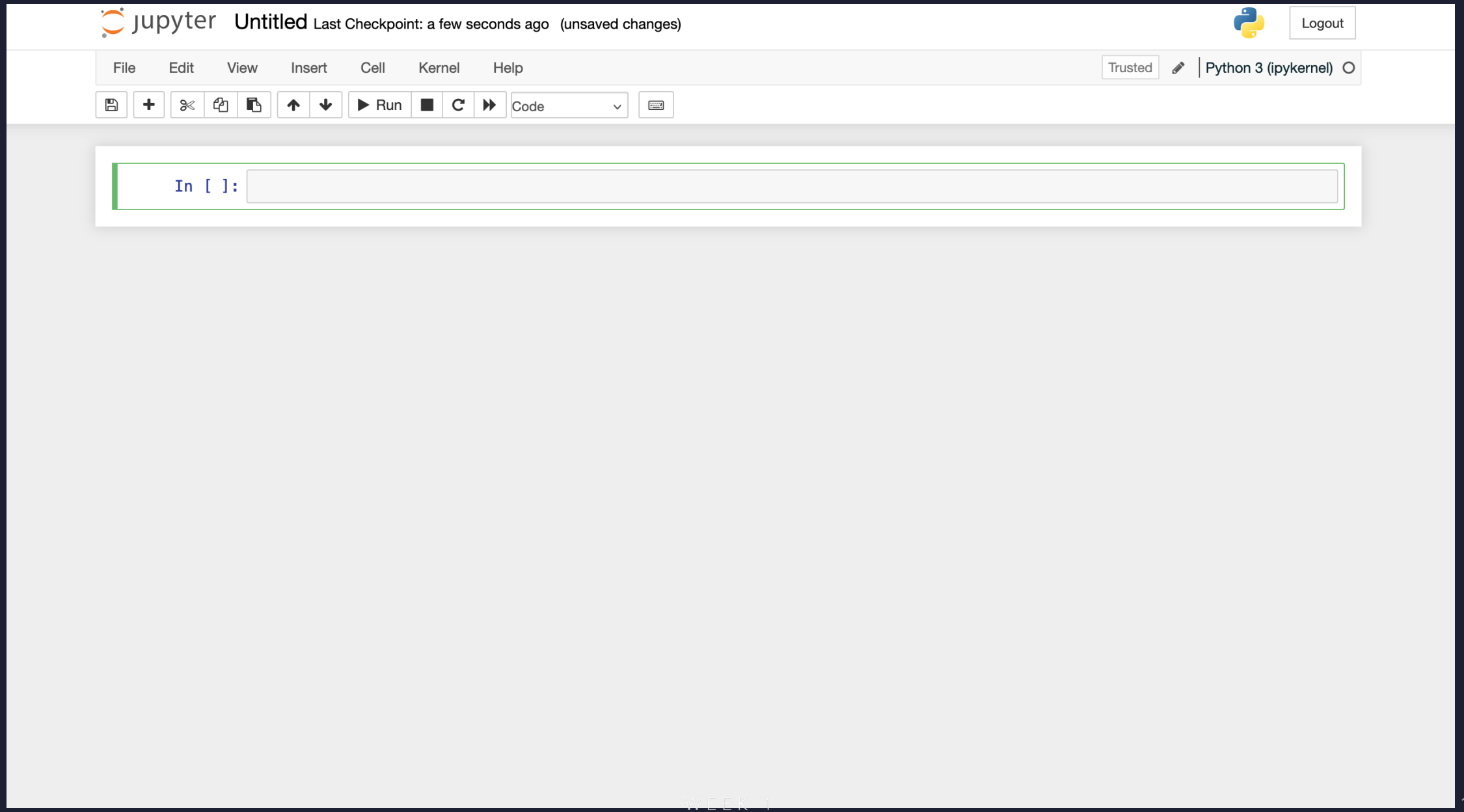

ANACONDA.NAVIGATOR
Connected to Cloud
Connect
Home
Environments
Learning
Community
All applications
on
base (root)
Channels
DataSpell
DataSpell is an IDE for exploratory data analysis and prototyping machine learning models. It combines the interactivity of Jupyter notebooks with the intelligent Python and R coding assistance of PyCharm in one user-friendly environment.
Install
Anaconda Notebooks
Cloud-hosted notebook service from Anaconda. Launch a preconfigured environment with hundreds of packages and store project files with persistent cloud storage.
Launch
Notebook
6.5.4
Web-based, interactive computing notebook environment. Edit and run human-readable docs while describing the data analysis.
Launch
Qt Console
5.4.2
PyQt GUI that supports inline figures, proper multiline editing with syntax highlighting, graphical calltips, and more.
Launch
Spyder
5.4.3
Scientific PYthon Development EnviRonment. Powerful Python IDE with advanced editing, interactive testing, debugging and introspection features
Launch
Datalore
Kick-start your data science projects in seconds in a pre-configured environment. Enjoy coding assistance for Python, SQL, and R in Jupyter notebooks and benefit from no-code automations. Use Datalore online for free.
Launch
IBM Watson Studio Cloud
IBM Watson Studio Cloud provides you the tools to analyze and visualize data, to cleanse and shape data, to create and train machine learning models. Prepare data and build models, using open source data science tools or visual modeling.
Launch
Oracle Data Science Service
OCI Data Science offers a machine learning platform to build, train, manage, and deploy your machine learning models on the cloud with your favorite open-source tools
Launch
Glueviz
1.2.4
Multidimensional data visualization across files. Explore relationships within and among related datasets.
Install
JupyterLab
3.6.3
An extensible environment for interactive and reproducible computing, based on the Jupyter Notebook and Architecture.
Install
Orange 3
3.34.0
Component based data mining framework. Data visualization and data analysis for novice and expert. Interactive workflows with a large toolbox.
PyCharm Professional
A full-fledged IDE by JetBrains for both Scientific and Web Python development. Supports HTML, JS, and SQL.
RStudio
1.1.456
A set of integrated tools designed to help you be more productive with R. Includes R essentials and notebooks.
Anaconda Toolbox
Supercharged local notebooks. Click the Toolbox tile to install.
Read the Docs
Documentation
Anaconda Blog
Launch Jupyter Notebook
WEEK 1
8

Creating a new Notebook

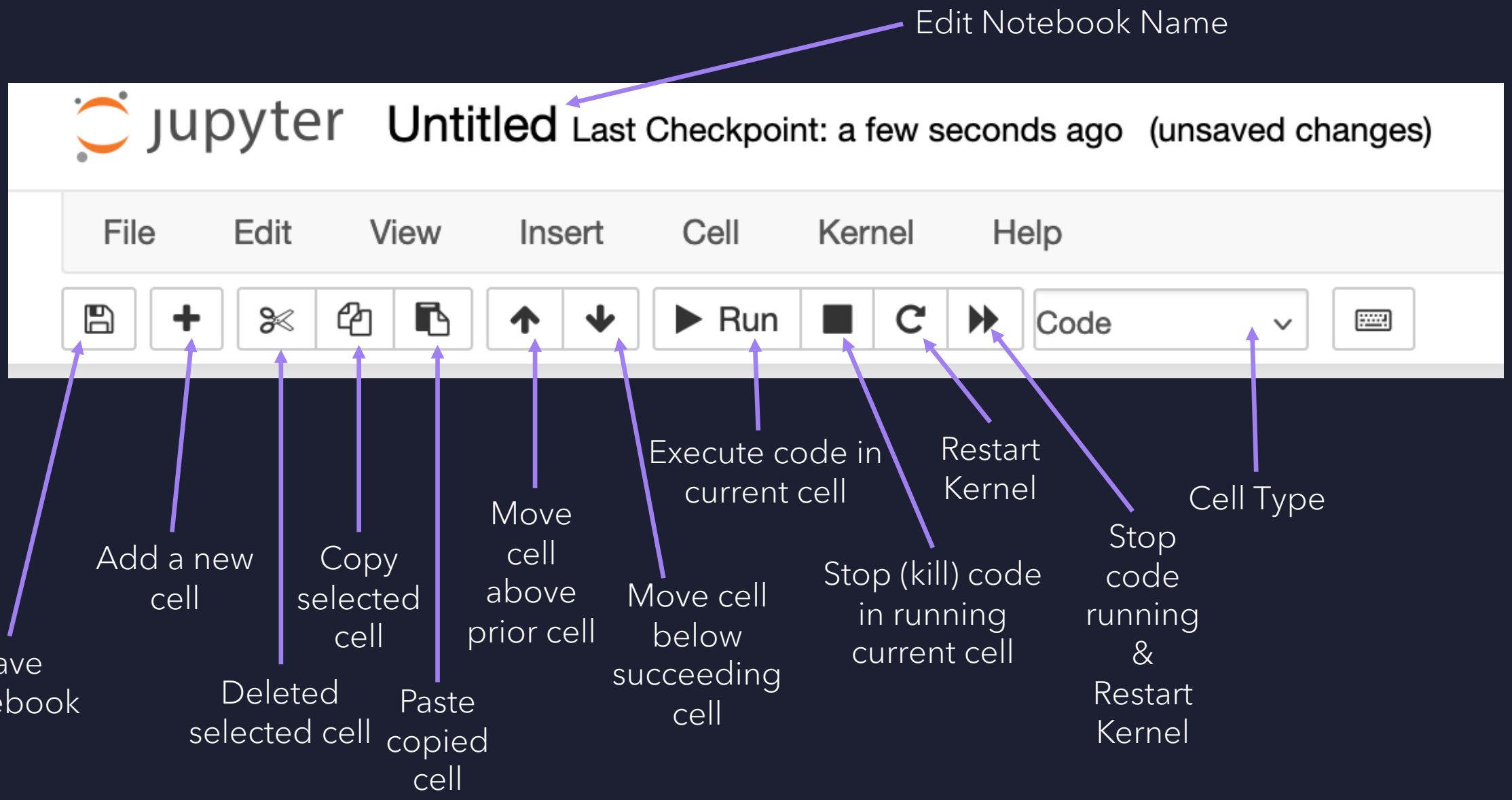


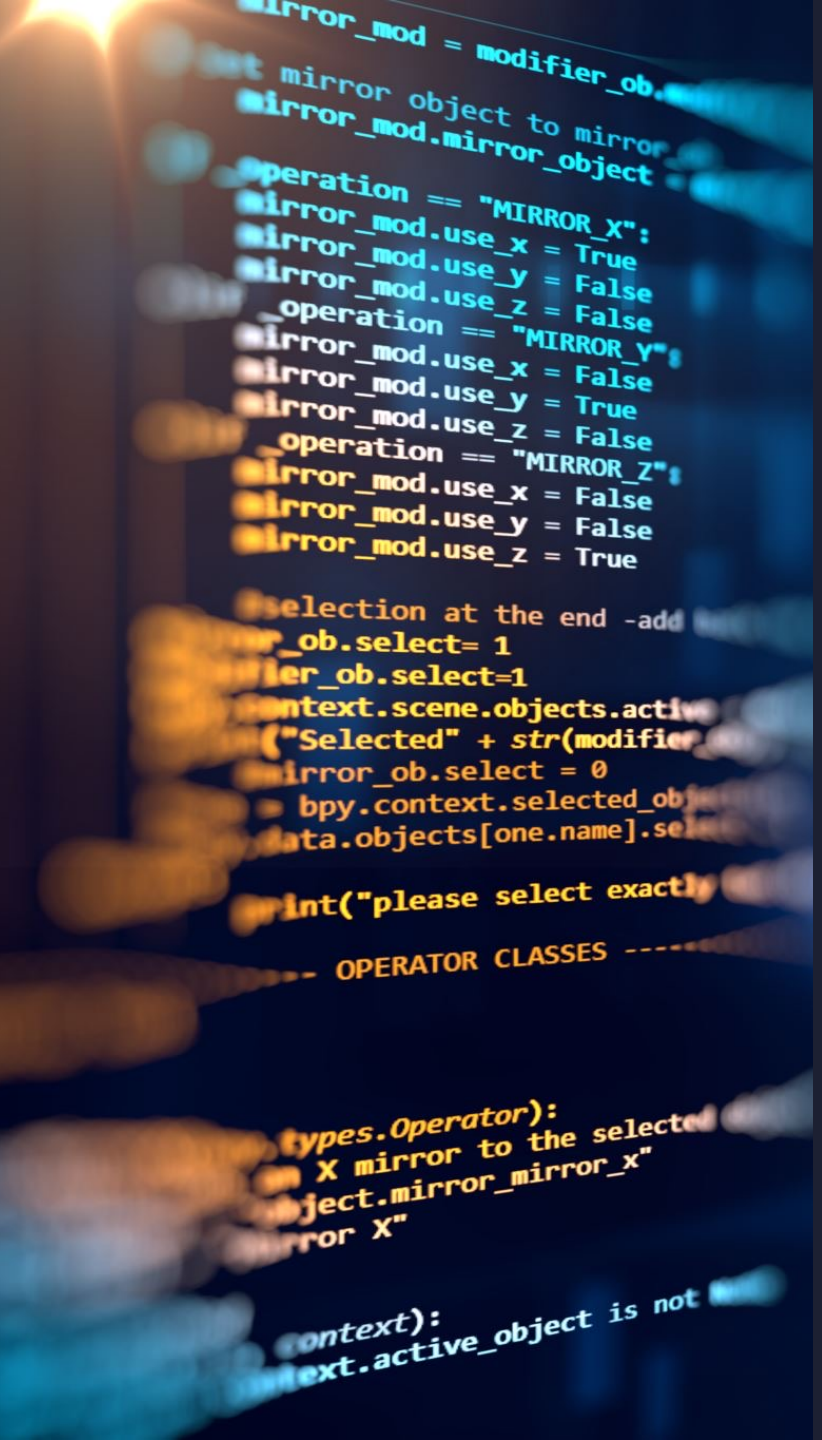
Creating a new Notebook

NEW NOTEBOOK IS MADE!



NOTEBOOK SHORTCUT BAR BUTTONS

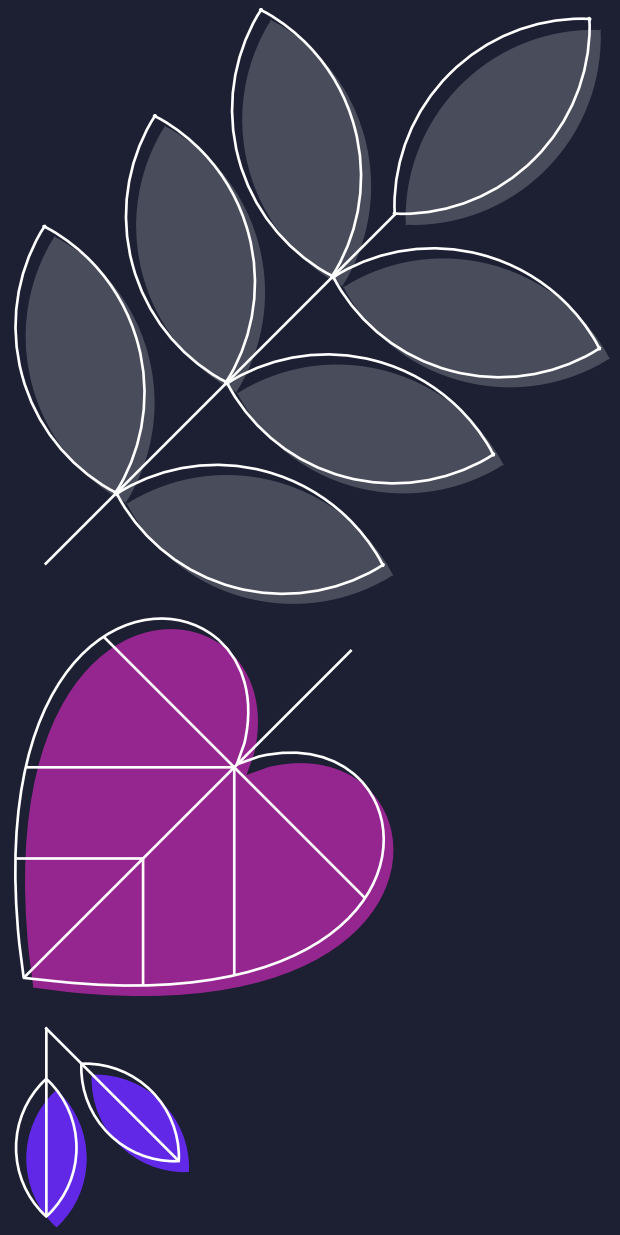




SOME PYTHON VOCAB

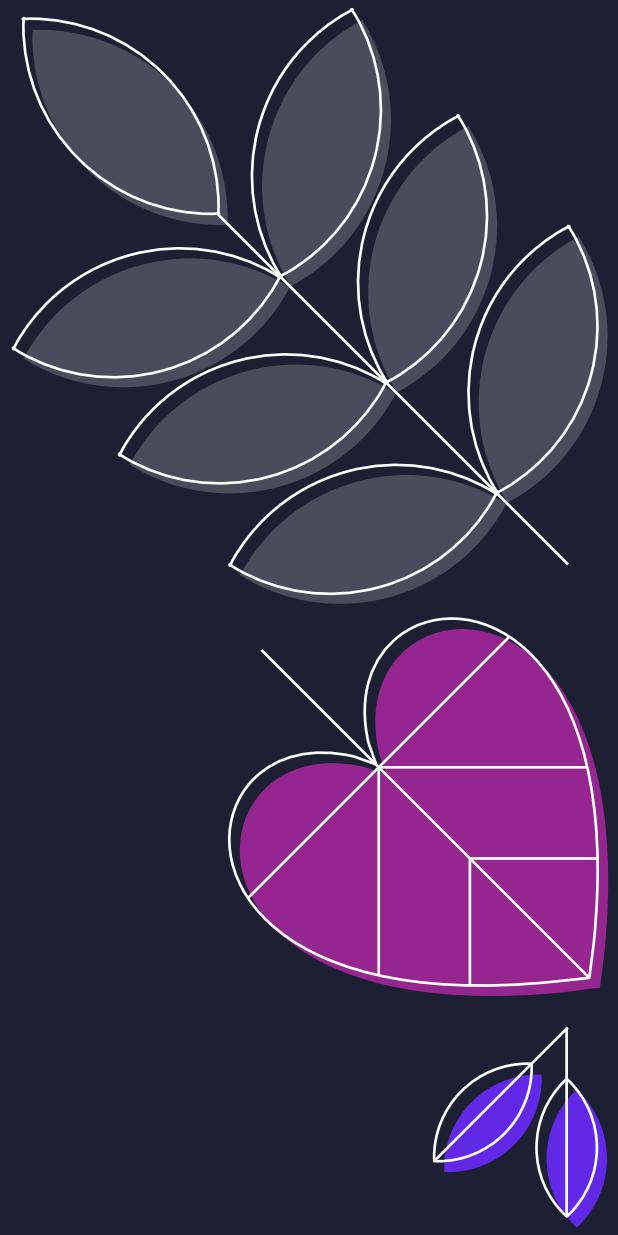
- Kernel: Code interpreter that executes code in Jupyter notebook cell line by line
- Console: Command line interpreter that executes code from scripts line by line
- Variable: a reserved memory location to store data/values
- Object: A variable that contains data or functions the can be used to manipulate data
- Element: Items/Values inside a list, array, matrix, etc.

DATA TYPES IN PYTHON



DATA CATEGORIES

- Numeric
- String
- List
- Boolean
- Dictionary



NUMERIC

Integer: 1, 1000, 786

Float: 0.87, 0.3333, 1.4

Complex: 8j, 5+ 2j, 80.0j

STRING

Declared using “double quotations” or ‘single quotations’:

“Hello World”

”1+2”

’There are 8 cookies’

LIST

- An ordered collection of values
- 1-D horizontal vector/array
- Denoted with square brackets []

Examples:

[0, “eleven”, 0.4, 8]

[1, 5, 9, 13]

BOOLEAN

- Logical Data Type
- Only two possible outputs: True or False

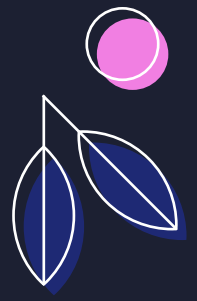
DICTIONARY

- Unordered collection of Data Values
- Uses Curly Brackets {}
- Syntax: {“Key”: Value}

BASIC PYTHON OPERATORS & FUNCTIONS

DECLARING A VARIABLE

- Python is object-orientated programming language
- Variables are such an object
- Variables store data
- Syntax: varname = data
- Naming Rules:
  - No Spaces (Use an _ instead!)
  - Variable Name cannot start with a number
  - No special symbols



BUILT-IN FUNCTIONS

- **len()**: Returns the length of the variable
- **type()**: Returns the data-type of a variable
- **print()**: Returns the value of a variable
- **float()**: Returns variable as a float (input types: integer or string only)
- **int()**: Returns variable as an integer
- **str()**: Returns variable as a string
- **bool()**: returns variables as a Boolean
  - Returns **False** when fed 0
  - Returns **True** for everything else

MATHEMATICAL OPERATORS

- Addition: +
- Subtraction: -
- Multiplication: *
- Division: /
- Exponent: **

LOGICAL OPERATORS

- Greater than: >
- Less than: >
- Greater than or equal to: >=
- Less than or equal to: <=
- Equal to: ==

OTHER FUNCTIONS

- Comment: Placing a # in a line causes what followed to be commented out
- Cells: #%% creates a new cell (not applicable for Jupyter notebooks)
- Comment Blocks: Placing ‘’’ above and below a block of code comments out the entire block
- max(): Returns the element with the largest value in a list
- min(): Returns the element with the smallest value in a list

PYTHON PACKAGES AND LIBRARIES

LIBRARIES & PACKAGES

- Libraries and Packages are external code you load to simplify your own script
- At the beginning of every script, you should load any libraries and packages you need
- Most used: NumPy, Matplotlib, & SciPy
- Built into Anaconda (Full list here)

Syntax

import package_name as shortcut_name

Ex.: import numpy as np

Let's try loading these in our notebook!

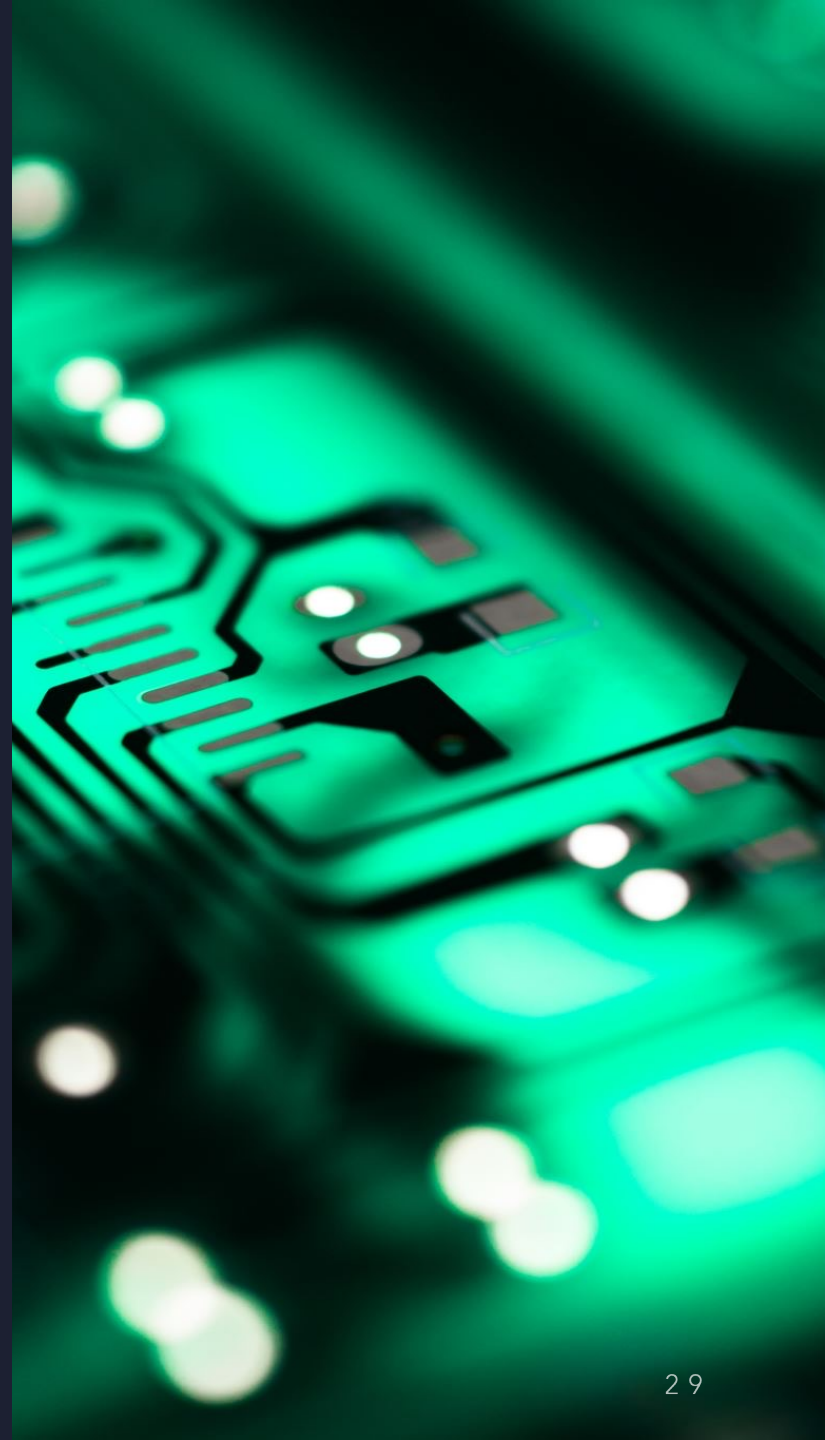
ALWAYS IMPORT PACKAGES AND LIBRARIES FIRST

First part of writing a python script is to import the necessary packages and libraries you will be using in your script.

NumPy

- Numerical Computing Library
- Introduces new data type "numpy array"
- Arrays are the better list
  - They can be multidimensional
  - Stores objects or "nested" sequences

Syntax: np.array([data])



OTHER NUMPY ARRAY FUNCTIONS

np.ones (shape): returns an array of ones of given shape/size

np.zeros (shape): returns an array of zeros of given shape/size

np.linspace(start,stop,length): returns array of size **length** from **start** to **stop**

np.arrange(start,stop,step): returns array from **start** to **stop** with **step** interval size between each element

QUICK INDEXING TUTORIAL

What is indexing?
Allow you to call an element of an array of list

To call a specific element of a list or array

Uses square brackets [] with position of element

Syntax: object[index]

Python starts counting at 0

INDEXING SYNTAX

- Calling a single element:
  variable[element position]
- Calling several element values:
  variable[start:stop:step]
  - If you leave step blank it assumes step=1

  Element position must be a WHOLE number

  Using a negative number reverses the order of list or array

  Starts from the end -> start

INDEXING STRINGS

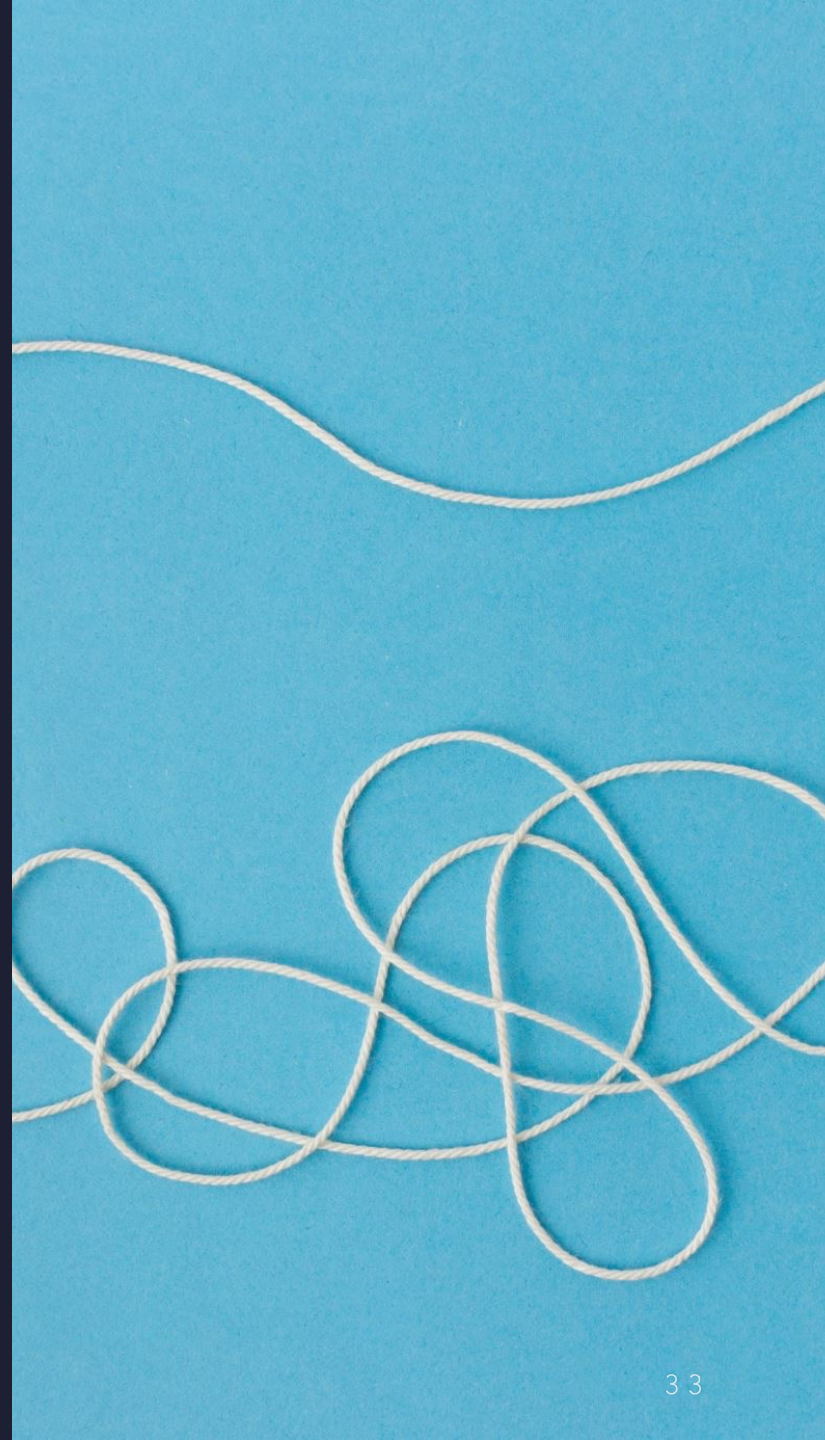
- You can index strings!
- It counts the characters within the string like elements of a list or array
- You can “splice” a string and it will return a string with only those characters

Example:

Var = “Hello World”

Var[1:5] -> “ello”

Note: Splice will cutoff at element before stated end point



MATHEMATICAL FUNCTIONS OF NUMPY

SIMPLE MATH FUNCTIONS OF NUMPY

np.round(input, decimal places): rounds input to the decimal place indication

np.sum(input): sums all the elements in an object

np.sqrt(input): takes the square root of an object

np.exp(input): calculates the exponential (e^{input}) of an object

np.log(input): take the natural logarithm (ln) of the input

np.log10(input): takes the logarithm with base 10 ($\log_{10}$) of the input

np.log2(input): takes the logarithm with base 2 ($\log_2$) of the input

np.abs(input): takes the absolute value of the input

TRIGONOMETRIC FUNCTIONS OF NUMPY

np.degrees(input): converts input from radians to degrees
Identical function: np.rad2deg()

np.radians(input): converts input from degrees to radians
Identical function: np.deg2rad()

np.sin(input): takes the sine of the input
np.arcsin(input): takes the inverse sine of the input

np.cos(input): takes the cosine of the input
np.arccos(input): takes the inverse cosine of the input

np.tan(input): takes the tangent of the input
np.arctan(input): takes the inverse tangent of the input

STATISTICAL FUNCTIONS OF NUMPY

np.max(input): returns the maximum value of the input object

np.min(input): returns the minimum value of the input object

np.median(input): returns the median of an object

np.mean(input): returns the mean of an object

np.average(input): returns the weighted average of an object

np.std(input): returns the standard deviation of an object

np.var(input): returns the variance of an object

np.histogram(input): returns the histogram of an object

MATHEMATICAL CONSTANTS IN NUMPY

MATHEMATICAL CONSTANTS IN NUMPY

- Pi (π): np.pi
- Infinity (∞): np.inf
- Negative infinity (-∞): np.ninf
- Euler's constant (e): np.e
- Not a Number (nan): np.nan

matplotlib

- Comprehensive library for creating static, animated, and interactive visualizations in Python
- It's the most used plot maker in Python
- Other plotting packages and libraries typically have some dependency on Matplotlib
- Pyplot is most common package

Import Matplotlib as:

```
import matplotlib.pyplot as plt
```

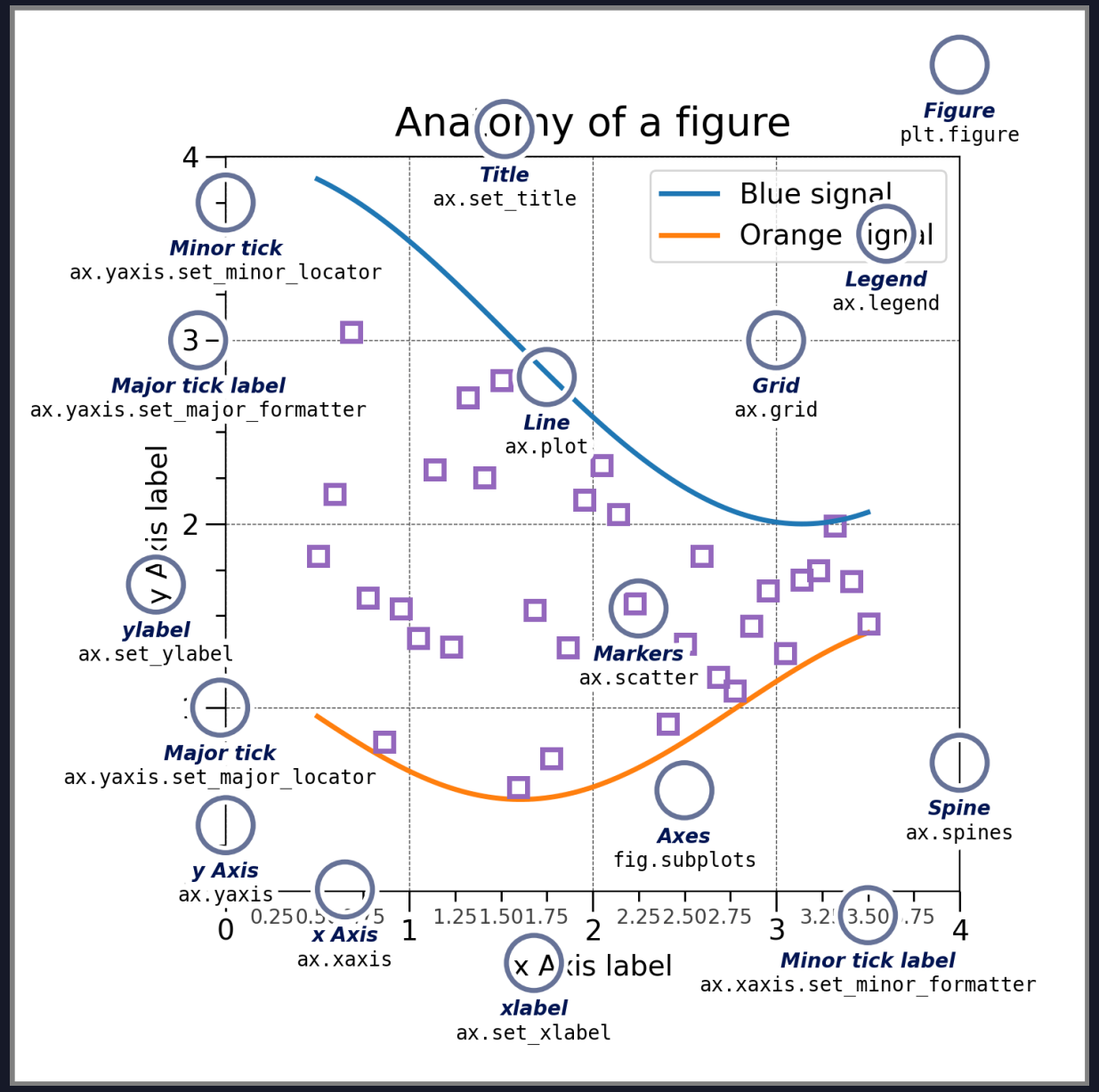
GETTING STARTED

- Make sure your lists/arrays are the **same length** (have the same number of elements)
- Always begin a new plot with creating a new **Figure**

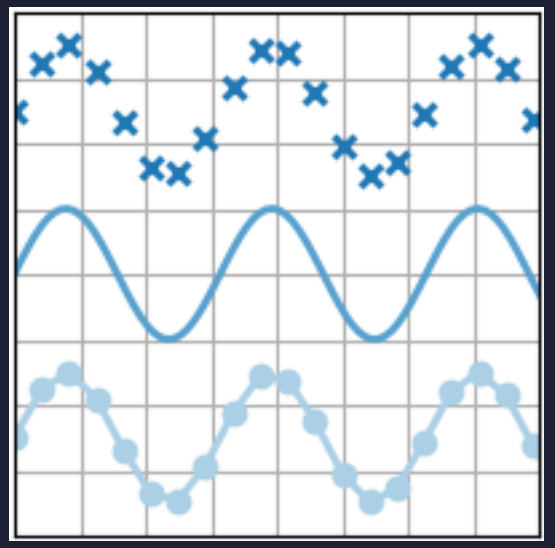
Figure: blank window which plots/ subplots are displayed on

- You overlap plots in a single **Figure**
- You can put multiple plots in a single figure with **subplots**

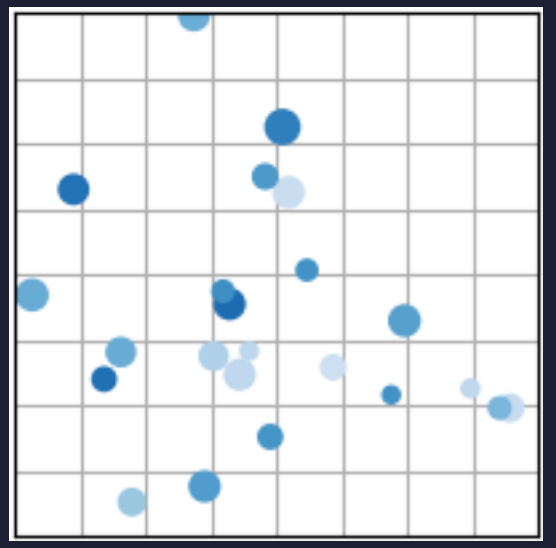
To create a new figure use **plt.figure()**



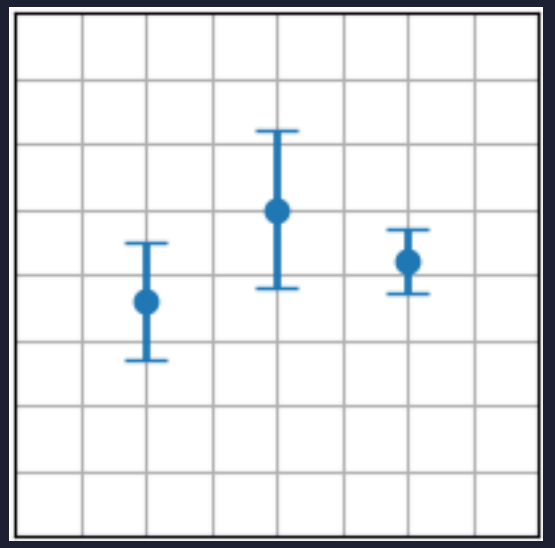
COMMON 2D PLOTS



plt.plot(x,y)

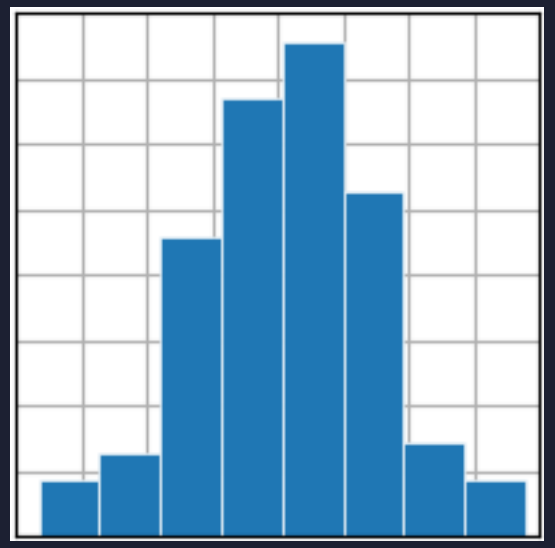


plt.scatter(x,y)

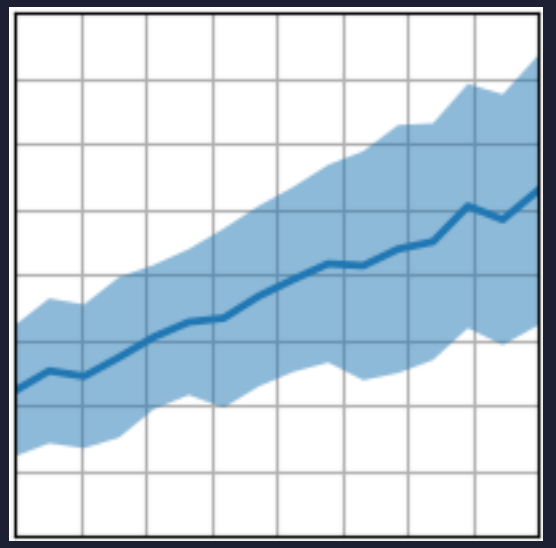


plt.errorbar(x,y,xerror,yerror)

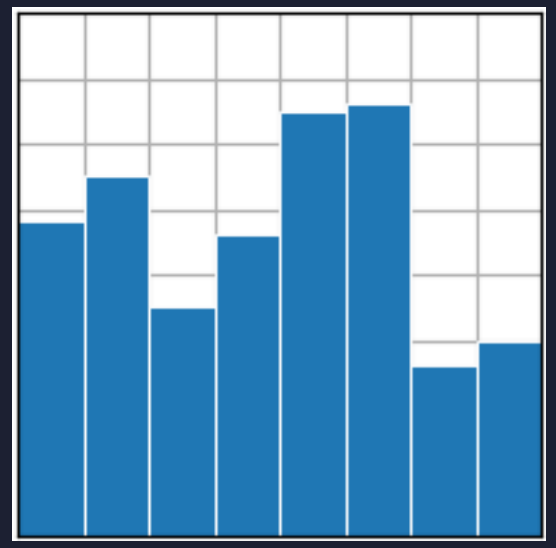
OTHER IMPORTANT PLOT TYPES



plt.hist(x)

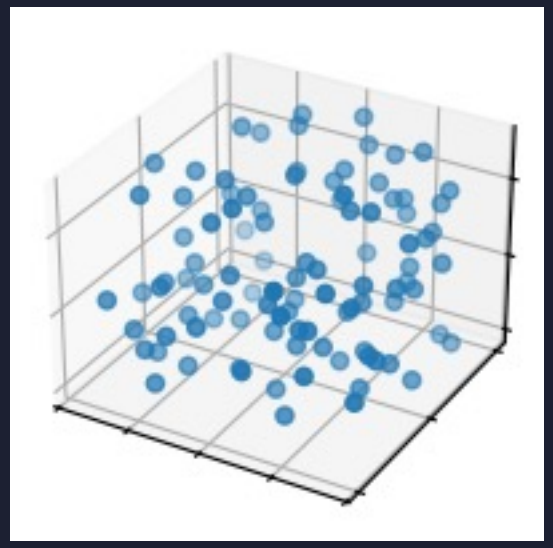


plt.fill_between(x,y_1,y_2)

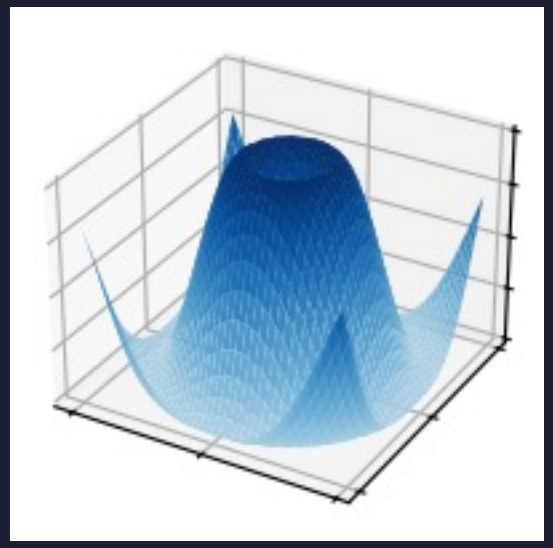


plt.bar(x,y)

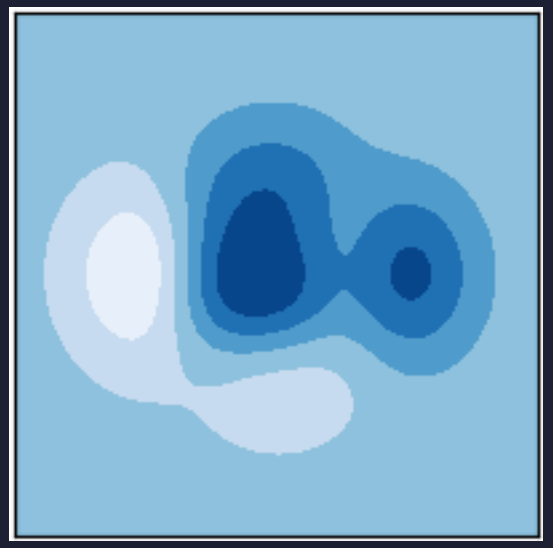
SOME 3D DIMENSIONAL PLOTS



plt.scatter(x,y,z)



plt.plot_surf(x,y,z)



plt.contourf(x,y,z)

CUSTOMIZE PLOTS

- There are a wide arrange of colors and markers you can use to customize your plot
- You can also add labels to the vertical and horizontal axes
  X-axis: plt.xlabel("String Input") & Y-axis: plt.ylabel("String Input")
- You can title your plot with the following function: plt.title("Sttring Input")

All label and titles require a string as a minimum input
There are customizations for font, font size, super/subscripts, symbols, etc.

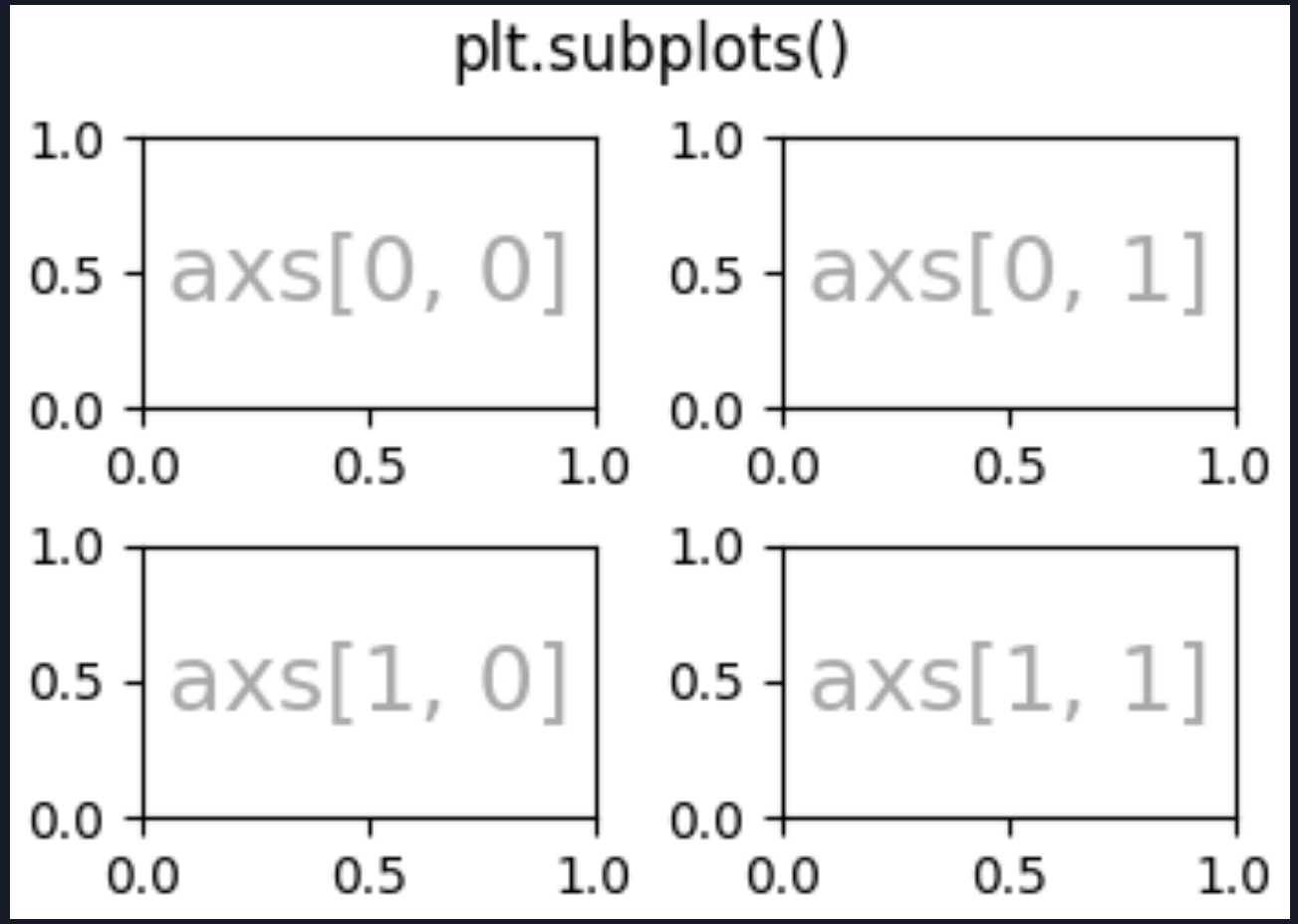
For multiple sets of data in a single plot window, you can add a label within the specific plot function you call (Ex. plt.plot(x,y,label="string")) and place a legend (plt.legend()) on the plot

LET'S TRY CREATING A PLOT IN JUPYTER NOTEBOOK

SUBPLOTS

- You can add multiple plot windows in the same figure using **plt.subplots(# rows, #columns)**
- The function gives two outputs a **figure** and **axes object**

    it can be a singular variable or an array of variable for each subplot

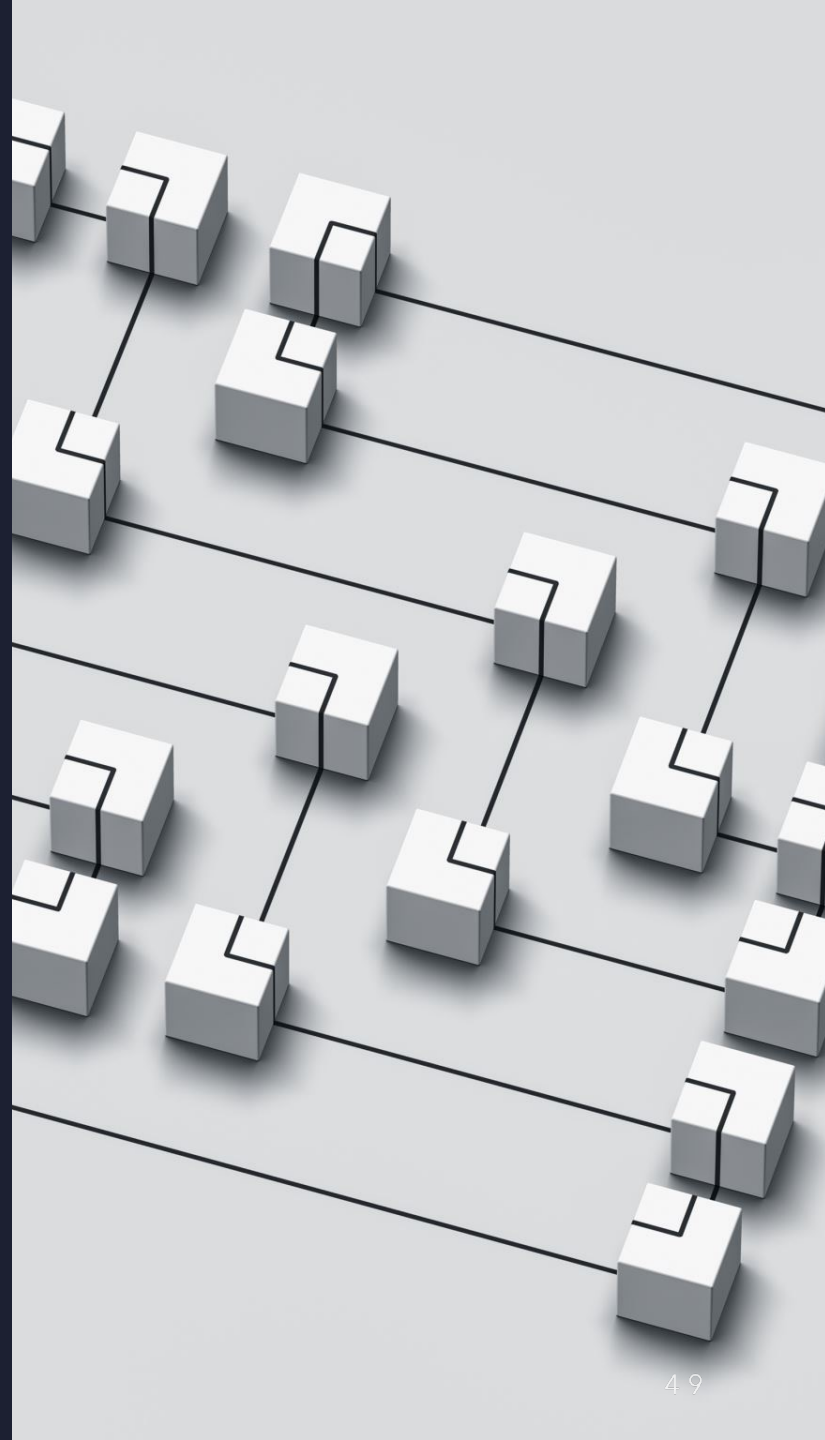


LET'S MAKE A FIGURE OF SUBPLOTS IN JUPYTER NOTEBOOKS

CUSTOMIZING SUBPLOTS

- Customizations can be made to each individual plot in a subplot figure
- For each axes variable output from **plt.subplots**, you are able perform the same customizations as the **plt.plot**
- Syntax: **axes_var.set_customization**

Let's try a few in Jupyter Notebook



- Library for scientific computing built from NumPy
- Used primarily to solve mathematical and scientific problems
- Capable of performing integration, linear algebra, solving ODEs, signal processing, etc.

We'll learn more about SciPy during Week 3 in some Data Processing

WEEK 1

A GOOD CHUNK OF CODING IS GOOGLING. GOOGLE AND STACK OVERFLOW ARE YOUR BEST FRIENDS

Google

stackoverflow

SUPPLEMENTAL

KEYBOARD SHORTCUTS

- Shift+Enter: to run
- Control+/: Comment/Uncomment current line
- Package/library Shortcut.Tab: to see list of functions in a package
- Tab: Autocompletes variable names and function names